

Total, Non-baseload, eGRID Subregion, State? Guidance on the Use of eGRID Output Emission Rates

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ABSTRACT

The purpose of this paper is to dispel the uncertainty surrounding the various Emissions & Generation Resource Integrated Database (eGRID) emission rates, in particular the output emission rates, and to answer the questions posed by many users. It is anticipated that as a result of this paper, future misuse of the eGRID data for carbon footprinting and emissions reductions projects will be prevented.

eGRID, developed by E.H. Pechan & Associated, Inc. for the Climate Protection Partnership Division's State and Local Branch, is the preeminent source of data on the environmental attributes of virtually all of the electric power generated in the United States, linking air emissions to electricity generated. The most recent data, the sixth edition of eGRID, eGRID2007, can be downloaded from the eGRID website, <http://www.epa.gov/egrid>.

This paper discusses how total output emission rates, combustion output emission rates, and non-baseload output emission rates are calculated. Names of specific plants that would or would not be included in the calculations of these rates for some particular examples will illuminate the differences among the methodologies for estimating these output rate values. The paper also relates how the eGRID plant data are aggregated to the different eGRID levels. Recommendations and reasons for the appropriate selection of the type of eGRID output emission rate and aggregation level for different purposes are offered.

INTRODUCTION

This paper dispels uncertainty surrounding the various eGRID emission rates, in particular the output emission rates, and answers questions posed by many users. It is anticipated that as a result of this paper, the proper use of eGRID data for greenhouse gas (GHG) emission inventories, carbon footprinting, and emissions reductions projects will be better ensured.

eGRID

The Emissions & Generation Resource Integrated Database (eGRID), developed by E.H. Pechan & Associates, Inc. for the U.S. Environmental Protection Agency's Climate Protection Partnership Division, is the preeminent source of data on the environmental attributes of virtually all of the electric power generated in the United States, linking air emissions to electricity generated. The most recent data, the sixth edition of eGRID, eGRID2007, was published in October 2008 (updated in January 2009) and can be downloaded from the eGRID website, <http://www.epa.gov/egrid>.

The eGRID plant file provides plant identification, the county and state in which the plant is located, structural information about the plant's operator and owners(s), both of which are electric generating companies (EGC), and the operator's parent company (if there is one). The plant file also displays the plant's power control area (PCA), which is the entity that dispatches power; and the plant's eGRID subregion and NERC region, both of which are associated with the plant's PCA.

eGRID operational data include emissions, different types of emission rates, generation, resource mix, and heat input. Emissions are reported for three greenhouse gases (GHGs) – carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O); two criteria pollutants – nitrogen oxides (NO_x), and sulfur dioxide (SO₂); and one toxic air pollutant, mercury (Hg). The plant's operational data are for a given year, and previously available plant files may be included in a new eGRID edition. For eGRID2007, the newest operational year of data is 2005 (and year 2004 data from eGRID2006 is also included). The fourth edition of eGRID has operational data from years 1996 through 2000.

What is unique in eGRID is that the data have been reconfigured to reflect a more current point in time, including plant ownership and operators, parent company affiliations, company mergers, and grid configurations. For example, in eGRID2007, the year 2005 data have been reconfigured to reflect the industry's current structure as of December 31, 2007. The reconfiguration works in the following example. A plant with specified environmental characteristics has owner(s) and an operator that is part of a parent company and is associated with an eGRID subregion, for example, by the end of year 2005. By 2007, the operator and owner(s) have changed, the new operator is associated with a different parent company (or no parent company), and the eGRID subregion, for example, has changed. In eGRID2007, the specified year 2005 environmental characteristics of this plant are attributed to the year 2007 operator, owner, parent company (or no parent company), and eGRID subregion -- not to those from year 2005. Hence, the name eGRID2007 (with year 2005 data) reflects the year 2007 industry configuration.

eGRID Coverage

The environmental characteristics in eGRID are those associated with the generation of electricity, not with the consumption of electricity. These values do not account for transmission and distribution losses, imports and exports among subregions, or life cycle emissions at electric generating units (e.g., emissions from the extraction, processing, and transportation of fuels).

eGRID output emission rates do not account for any losses between the points of consumption and the points of generation. For example, because there are line losses, one kilowatt hour of electricity consumption requires a little more than one kilowatt hour of electricity generation. To account for transmission and distribution line losses when applying eGRID output emission rates to electricity consumption within a certain region, multiply the consumption by a transmission and distribution system loss factor and add it to the consumption. In the state import-export file, eGRID publishes gross grid loss factors, which can be used to account for line losses. These eGRID grid loss factors are based on generation, consumption, and imports within groups of states that generally comprise the three grid regions in the continental U.S., and Alaska and Hawaii.

eGRID Adjustments

Two adjustments to the operational data (emissions and heat input) also separate eGRID data from some of the other available Federal data: at the plant level, adjustments are made for the burning of biomass and for the facility designation as a combined heat and power (CHP) plant. eGRID uses the adjusted emissions to estimate the output emissions rates for the different aggregation levels.

eGRID assumes that biomass, a fuel derived from organic matter, including, but not limited to, wood and paper products, agricultural waste, or methane (e.g., from landfills), is subject to the natural carbon cycle and does not contribute to global warming. Thus, all biomass CO₂ emissions (including those from renewable methane) are assigned a value of zero because these organic materials would otherwise release CO₂ (or other GHGs) through decomposition. Furthermore, eGRID assumes that renewable methane, such as landfill gas and digester gas, used to generate electricity would have otherwise been flared, because flaring is usually required if the gas is not used to generate electricity. The amount of incremental NO_x and SO₂ emissions attributable to utilizing renewable methane to generate electricity is what is considered for eGRID's emissions, which are adjusted by decreasing the uncontrolled emission factors (used to estimate the emissions) by the emissions factor represented by a typical flare. For CO₂, CH₄, and N₂O, the emission factors are assumed to be the same as the flares', so there are no incremental CO₂, CH₄, and N₂O emissions attributable to utilizing renewable methane to generate electricity, and values of zero are assigned.

As its name states, eGRID's emissions represent emissions from fuel only used for generating electricity. A CHP on the other hand, not only produces electricity, but also useful thermal energy that is used for industrial, commercial, heating, or cooling purposes. CHP, also known as cogeneration, converts energy more efficiently than facilities that separately produce heat and electricity. The plants labeled as CHP in eGRID are an EPA designation based on a CHP file developed for the U.S. Department of Energy. Since emissions reported in eGRID represent electricity generation only, emissions associated with useful thermal output – the amount of heat produced in a CHP facility that is used for purposes other than making electricity – are excluded (and a plant's emissions data reported in eGRID may be different from that reported in other EPA sources). A CHP plant's adjusted emissions and unadjusted emissions (the emissions associated with both the electric generation and the useful thermal output) are displayed in eGRID. However, only the adjusted emissions are used for the output emission rates at the plant and aggregation levels.

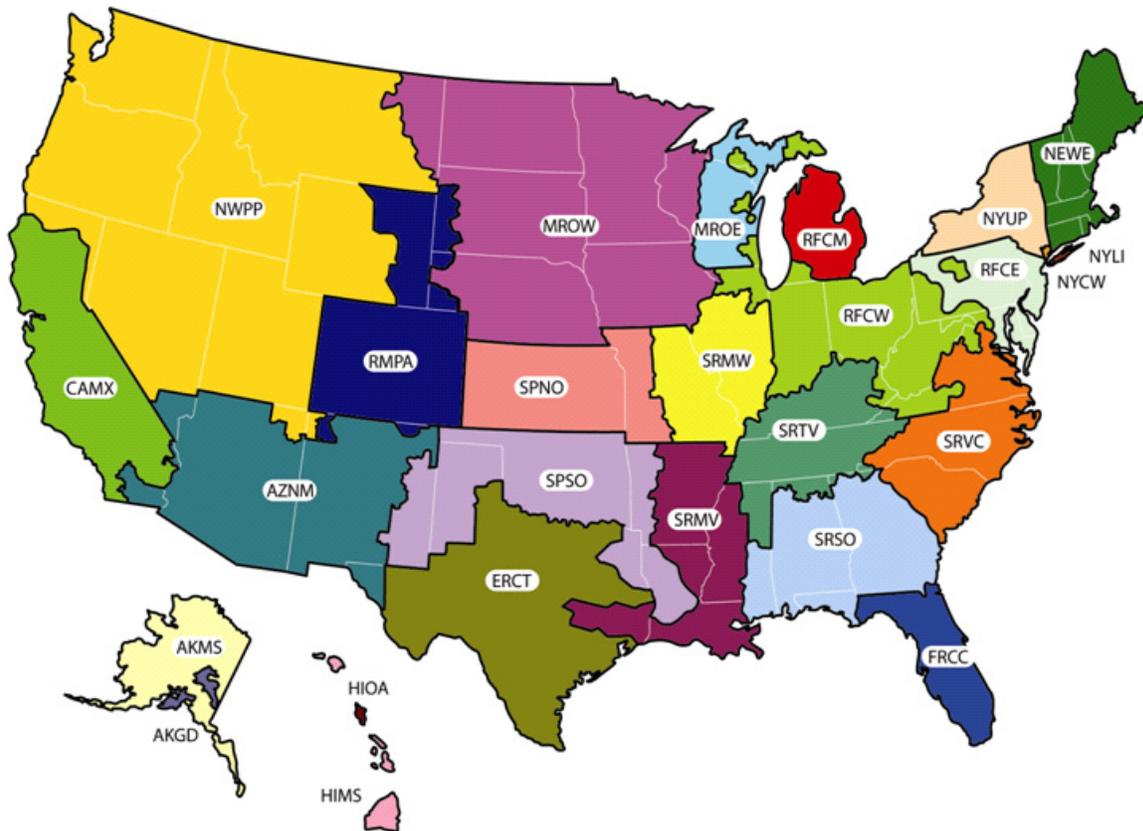
eGRID Aggregation Levels

The different levels of aggregation of the data are state, electric generating company (EGC), parent company, power control area (PCA), eGRID subregion, NERC region, and the U.S. total; there also are the plant, boiler, and generator levels of eGRID data. Development of the aggregate data begins with the plant level data. Each plant record includes the operator (also known as the location (operator)-based EGC), the owner(s) (also known as the owner-based EGC(s), the operator's parent company (also known as the location (operator)-based parent company), the plant's PCA, the plant's eGRID subregion and the plant's NERC region. When aggregating to any one of these aforementioned aggregation levels, the values of the emissions, net generations, heat input, and nameplate capacity of the plants are attributed to that entity (and in the case of multiple owner EGCs, the plant ownership percentage of each of these). Thus, the emissions, net generations, heat input, and nameplate capacity of all plants whose PCA is PJM Interconnection, for example, will be summed, and emission rates and resource mix will be calculated for this PCA.

Sometimes the composition of non-state level aggregations levels may not be geographically obvious. In particular, the plant composition of the state of Florida and the eGRID subregion/NERC region FRCC are not the same; nor is the state of Texas' and the eGRID subregion ERCOT's/NERC region TRE's, nor the state of California's and the eGRID subregion CAMX's. The Intermountain Power Project plant is a good illustration. Although this plant is in the state of Utah, not California, it is in the eGRID subregion CAMX because its utility operator is the City of Los Angeles, which is connected to the eGRID subregion through the Los Angeles Department of Water and Power PCA.

eGRID subregions are identified and defined by EPA – using the NERC regions and PCAs as a guide. An eGRID subregion is often, but not always, equivalent to an Integrated Planning Model (IPM) subregion. The 26 eGRID subregions in eGRID2007 are subsets of the NERC regions as configured on December 31, 2007 (see Figure 1). The plant’s associated PCA determines the plant’s associated eGRID subregion, which is defined as a subset of the NERC region and is composed of entire PCAs, with the exception of PJM Interconnection and New York Independent System Operator PCAs (each is associated with three eGRID subregions).

Figure 1. eGRID2007 eGRID subregion representational map.



eGRID Annual Output Emission Rates

There are various eGRID emission rates at the different levels of aggregation, but three annual output emission rates in particular relate the emissions to generation and serve different purposes in eGRID: annual [total] output emission rates, annual combustion output emission rates, and annual non-baseload output emission rates. They are described below.

Total Output Emission Rates

eGRID annual “total” output emission rate is the measure of the emissions as it relates to the generation output. (Note that in this paper, the word total is used in the term “total output emission rate.” However, in the eGRID2007 files, the word total is absent.) It is calculated as the emissions mass value divided by the generation MWh multiplied by a unit conversion factor. Units are in lb/MWh (lb/GWh for CH₄, N₂O, and Hg).

The eGRID subregion total output emission rates are the underlying data for EPA's Power Profiler tool (<http://epa.gov/cleanenergy/energy-and-you/how-clean.html>), which allows the user to assess the impacts of electricity use as well as to compare the fuel mix and air emission rates of the electricity in the user's region with that of the nation. These rates are also the underlying data for EPA's Personal Emissions Calculator (http://epa.gov/climatechange/wycd/calculator/ind_calculator.html), which helps the user to estimate a personal (or family) carbon footprint. Additionally, the eGRID subregion total output emission rates are used for estimating scope 2 indirect emissions under The Climate Registry (TCR), The California Climate Action Registry (CCAR), and EPA Climate Leaders protocols.

Combustion Output Emission Rates

The combustion output emission rate provides a true picture of the emitting plant sources, which may include a combination of both combustion and noncombustion generators. Whereas the generation used in the denominator for calculating the traditional total output emission rate is the total net generation, the denominator used for calculating the combustion output emission rate is the net generation associated with emissions, namely, the combustion generation only. Thus, net generation from nuclear, hydro, geothermal, solar, and wind is not included in the calculation of this rate.

Non-baseload Output Emission Rates

The non-baseload output emission rates were developed to provide an improvement over the fossil fuel output emission rates as an estimate of emission reduction benefits from energy efficiency and clean energy projects. Demand for electricity changes diurnally and seasonally. The term "baseload" refers to those plants that supply electricity to the grid when demand for electricity is low. Baseloaded plants are usually called upon to provide electricity to the grid no matter what the demand for electricity is during any given period of time, and generally operate except when undergoing routine or unscheduled maintenance. Non-baseload emission rates are a slice of the system total mix, with a greater weight given to plants that operate coincident with peak demand for electricity. In eGRID, the capacity factor of each plant is used as a surrogate for determining whether a plant is baseloaded and how much of each plant's generation is considered to be non-baseloaded. Non-baseload emission rates are the output emission rates for plants that combust fuel and have capacity factors less than 0.8, weighted by generation and a percent of generation determined by capacity factor. The non-baseload emissions and generation include only emissions and generation from combustion sources and exclude emissions and generation from plants that have high capacity factors. The remaining emissions and generation are weighted by a factor which is a function of capacity factor. These data values are derived from plant level data and factor out baseload generation, which is generally unaffected by measures that affect marginal generation. This rate is the sum of the non-baseload emissions divided by the sum of non-baseload net generation, divided by a unit conversion factor. In eGRID, these values are displayed beginning at the state aggregation level.

eGRID subregion CO₂ non-baseload output emission rates are the underlying data in EPA's Greenhouse Gas Equivalencies Calculator (<http://epa.gov/cleanenergy/energy-resources/calculator.html>) since the results of the calculation is the potential amount of avoided CO₂ emissions. These rates are also the underlying data for EPA's Green Power Equivalency Calculator (<http://www.epa.gov/greenpower/pubs/calculator.htm>), which helps to translate a green power kWh purchase into more understandable everyday terms such as equivalencies to coal plant CO₂ emissions or greenhouse gas emissions from passenger vehicles or CO₂ emissions from electricity use in American homes, for example.

Examples

Some examples of plants that would be included in the calculation of one output emission rate and not the other may clarify the differences between the rates.

In Florida, the Crystal River plant has coal burning steam and nuclear generators and the Turkey Point plant has nuclear and combustion (diesel burning IC engines and residual oil burning steam turbines) generators. The total output emissions rate for the Florida plants would include all the generators' net generation from both plants; the combustion output emissions rate would not include the nuclear generators' net generation from either plant. Similarly, in South Carolina, the Jefferies plant has coal and residual oil burning steam turbines as well as hydroelectric generators. The combustion output emissions rate for the South Carolina plant would not include the hydro generators' net generation, whereas the total output emission rate would.

In Alabama in 2005, the Gorgas coal plant (with a nameplate capacity of 1417 MW and net generation of 7.91 million MWh) operated at almost 64% capacity factor, while the Charles Lowman coal plant (with a nameplate capacity of 538 MW and net generation of 3.86 million MWh) operated at an 82% capacity factor. The Gorgas and Charles Lowman plants would be included in both the total output emission rate calculations for Alabama. However, while 27 percent of the generation and emissions from the Gorgas plant would be included in the non-baseload output emissions rate for Alabama, the Charles Lowman plant would be excluded from the non-baseload output emission rate calculations for Alabama.

Tables 1 and 2 display the eGRID subregion and state, respectively, output emission rates for CO₂, CH₄, and N₂O for eGRID2007 (year 2005 data). Looking at Table 1, it is not easy to discern any particular pattern for the three eGRID subregion output emission rates except that the combustion rate values are the same or greater than the total rates (because the numerator is the same but the denominator used for the combustion rate calculation is the same or smaller than the total rate denominator). The non-baseload rate varies because of the many factors affecting its estimation. It can be less than the total rate, greater than the combustion rate, or in between the total and combustion rates.

Table 3 displays the eGRID subregion carbon dioxide equivalent (CO₂e) output emission rates calculated using the eGRID subregion output emission rates for CO₂, CH₄ and N₂O and the Global Warming Potentials from the International Panel on Climate Change's Second Assessment Report. This table shows the relative contributions of including the CH₄ and N₂O emissions from electric generation along with the CO₂ emissions. The eGRID subregion CO₂e output emission rates are 0.2 to 1.4% higher than the CO₂ output emission rates.

Table 1. eGRID subregion and U.S. greenhouse gas annual output emission rates comparison (eGRID2007 version 1.1, year 2005 data).

eGRID subregion acronym	eGRID subregion name	Carbon Dioxide (CO2) (lb/MWh)			Methane (CH4) (lb/GWh)			Nitrous Oxide (N2O) (lb/GWh)		
		total	combustion	non-baseload	total	combustion	non-baseload	total	combustion	non-baseload
SUBRGN	SRNAME	SRCO2RTA	SRCO2CRT	SRNBCO2	SRCH4RTA	SRCH4CRT	SRNBCH4	SRN2ORTA	SRN2OCRT	SRNBN2O
AKGD	ASCC Alaska Grid	1,232.36	1,395.97	1,473.43	25.60	29.00	36.41	6.51	7.37	8.24
AKMS	ASCC Miscellaneous	498.86	1,466.94	1,457.11	20.75	61.02	60.47	4.08	11.99	11.87
ERCT	ERCOT All	1,324.35	1,530.29	1,118.86	18.65	21.55	20.15	15.11	17.47	5.68
FRCC	FRCC All	1,318.57	1,530.50	1,353.72	45.92	53.30	48.16	16.94	19.66	12.95
HIMS	HICC Miscellaneous	1,514.92	1,689.44	1,674.15	314.68	350.93	338.44	46.88	52.28	51.42
HIOA	HICC Oahu	1,811.98	1,811.98	1,855.10	109.47	109.47	120.11	23.62	23.62	20.79
MROE	MRO East	1,834.72	2,130.47	1,828.63	27.59	32.04	28.82	30.36	35.26	25.20
MROW	MRO West	1,821.84	2,301.48	2,158.79	28.00	35.37	45.57	30.71	38.79	35.22
NYLI	NPCC Long Island	1,536.80	1,536.80	1,509.85	115.41	115.41	60.32	18.09	18.09	10.78
NEWE	NPCC New England	927.68	1,357.36	1,314.53	86.49	126.56	77.47	17.01	24.89	16.02
NYCW	NPCC NYC/Westchester	815.45	1,451.96	1,525.05	36.02	64.14	56.80	5.46	9.72	9.08
NYUP	NPCC Upstate NY	720.80	1,552.84	1,514.11	24.82	53.47	45.30	11.19	24.11	18.41
RFCE	RFC East	1,139.07	1,876.76	1,790.50	30.27	49.88	41.61	18.71	30.83	24.36
RFCM	RFC Michigan	1,563.28	1,840.29	1,663.15	33.93	39.95	29.40	27.17	31.98	26.24
RFCW	RFC West	1,537.82	1,999.02	1,992.86	18.23	23.70	24.49	25.71	33.42	31.72
SRMW	SERC Midwest	1,830.51	2,102.58	2,101.16	21.15	24.29	25.66	30.50	35.03	32.92
SRMV	SERC Mississippi Valley	1,019.74	1,373.25	1,257.10	24.31	32.74	29.50	11.71	15.76	9.82
SRSO	SERC South	1,489.54	1,877.36	1,697.22	26.27	33.11	35.20	25.47	32.10	26.41
SRTV	SERC Tennessee Valley	1,510.44	2,074.13	1,998.36	20.05	27.53	28.25	25.64	35.21	32.86
SRVC	SERC Virginia/Carolina	1,134.88	1,912.70	1,781.28	23.77	40.06	40.09	19.79	33.35	27.46
SPNO	SPP North	1,960.94	2,283.46	2,169.74	23.82	27.73	31.18	32.09	37.36	31.99
SPSO	SPP South	1,658.14	1,738.34	1,379.05	24.98	26.19	24.40	22.61	23.70	12.04
CAMX	WECC California	724.12	1,225.65	1,083.02	30.24	51.18	39.24	8.08	13.67	5.55
NWPP	WECC Northwest	902.24	1,917.04	1,333.64	19.13	40.65	49.28	14.90	31.66	18.73
RMPA	WECC Rockies	1,883.08	2,063.83	1,617.71	22.88	25.08	22.42	28.75	31.51	20.14
AZNM	WECC Southwest	1,311.05	1,691.01	1,201.44	17.45	22.51	20.80	17.94	23.13	8.50
		USCO2RTA	USCO2CRT	USNBCO2	USCH4RTA	USCH4CRT	USNBCH4	USN2ORTA	USN2OCRT	USNBN2O
US		1,329.35	1,810.88	1,583.28	27.27	37.14	35.77	20.60	28.07	19.97

Table 2. State greenhouse gas annual output emission rates comparison (eGRID2007 version 1.1, year 2005 data).

State	Carbon Dioxide (CO2) (lb/MWh)			Methane (CH4) (lb/GWh)			Nitrous Oxide (N2O) (lb/GWh)		
	total	combustion	non-baseload	total	combustion	non-baseload	total	combustion	non-baseload
PSTATABB	STCO2RTA	STCO2CRT	STNBCO2	STCH4RTA	STCH4CRT	STNBCH4	STN2ORTA	STN2OCRT	STNBN2O
AK	1,089.79	1,402.00	1,470.56	24.66	31.72	40.63	6.04	7.76	8.87
AL	1,340.53	1,927.90	1,723.00	25.10	36.10	41.29	23.08	33.20	28.23
AR	1,229.23	1,895.07	1,572.16	31.98	49.30	45.70	22.30	34.38	24.18
AZ	1,158.58	1,700.26	1,175.38	15.53	22.80	20.04	15.93	23.38	9.39
CA	540.06	1,016.69	1,061.13	30.60	57.61	39.98	4.50	8.47	4.90
CO	1,910.88	1,994.03	1,606.13	23.48	24.50	22.10	29.26	30.54	20.35
CT	803.92	1,540.25	1,478.77	67.79	129.88	77.68	13.63	26.11	17.37
DC	2,432.30	2,432.30	2,432.30	104.97	104.97	104.97	21.00	21.00	21.00
DE	2,018.04	2,018.04	1,947.85	36.49	36.49	39.23	26.52	26.52	23.37
FL	1,340.54	1,544.45	1,382.92	45.73	52.68	47.46	17.68	20.37	14.04
GA	1,402.54	1,892.22	1,654.63	22.02	29.70	33.18	23.93	32.28	24.93
HI	1,731.01	1,781.16	1,800.75	165.40	170.19	185.69	29.96	30.83	29.99
IA	1,907.24	2,277.12	2,240.01	22.38	26.72	27.16	31.62	37.75	36.15
ID	133.73	634.12	653.57	19.16	90.86	72.11	3.44	16.29	13.81
IL	1,126.00	2,172.65	2,097.08	13.15	25.37	25.51	18.50	35.70	32.78
IN	2,087.75	2,094.80	2,120.76	24.54	24.62	25.55	34.76	34.88	33.93
KS	1,894.92	2,374.19	2,351.42	23.25	29.13	37.22	31.31	39.23	34.58
KY	2,057.45	2,121.67	2,113.67	24.13	24.89	25.68	34.91	36.00	35.31
LA	1,175.49	1,429.86	1,294.94	25.45	30.96	27.53	13.42	16.32	10.02
MA	1,262.91	1,446.83	1,295.66	68.41	78.37	44.94	17.23	19.74	12.48
MD	1,352.27	1,964.61	1,964.52	34.58	50.24	50.19	22.73	33.02	31.08
ME	739.65	964.04	1,261.17	229.01	298.48	264.00	32.49	42.35	37.23
MI	1,347.55	1,853.88	1,698.29	29.65	40.79	29.59	23.65	32.54	26.93
MN	1,594.67	2,237.06	2,102.88	38.72	54.32	72.75	28.49	39.97	36.74
MO	1,846.93	2,056.93	2,031.97	21.31	23.73	25.04	30.71	34.20	31.25
MS	1,225.77	1,578.73	1,473.67	26.49	34.12	29.27	17.42	22.44	16.86
MT	1,592.05	2,423.78	2,760.93	19.73	30.04	75.25	27.20	41.41	50.35
NC	1,224.97	1,887.21	1,952.11	19.82	30.54	29.80	21.32	32.84	31.41
ND	2,325.16	2,444.76	2,508.90	25.10	26.39	41.00	37.35	39.28	41.71
NE	1,605.90	2,329.07	2,172.49	18.58	26.94	29.03	26.69	38.71	29.49

Table 2 (continued).

State	Carbon Dioxide (CO2) (lb/MWh)			Methane (CH4) (lb/GWh)			Nitrous Oxide (N2O) (lb/GWh)		
	total	combustion	non-baseload	total	combustion	non-baseload	total	combustion	non-baseload
PSTATABB	STCO2RTA	STCO2CRT	STNBCO2	STCH4RTA	STCH4CRT	STNBCH4	STN2ORTA	STN2OCRT	STNBN2O
NH	788.28	1,456.30	1,362.59	61.00	112.70	63.24	15.01	27.72	15.84
NJ	718.57	1,477.91	1,464.80	30.22	62.15	35.42	10.79	22.18	17.03
NM	1,935.90	1,990.26	1,480.82	23.28	23.93	24.85	30.53	31.38	10.41
NV	1,440.79	1,553.34	1,254.35	20.02	21.59	22.07	17.85	19.24	7.26
NY	828.33	1,523.20	1,517.76	36.96	67.97	51.98	10.41	19.14	13.83
OH	1,771.84	1,963.63	1,988.51	20.99	23.26	24.17	29.90	33.14	32.48
OK	1,562.76	1,640.35	1,293.63	21.67	22.74	21.57	20.44	21.45	10.08
OR	401.45	1,114.52	999.75	16.97	47.10	42.47	4.80	13.33	11.10
PA	1,244.50	1,939.05	1,845.16	25.42	39.60	34.63	20.94	32.63	25.71
RI	964.72	965.79	1,053.31	19.21	19.24	21.14	1.98	1.98	2.20
SC	893.86	1,923.57	1,760.87	14.92	32.11	28.36	15.17	32.65	25.34
SD	1,181.45	2,342.98	2,224.28	13.96	27.69	29.49	19.03	37.75	29.90
TN	1,259.07	2,019.03	2,050.63	16.41	26.32	26.41	21.69	34.78	34.99
TX	1,355.41	1,523.39	1,138.47	19.75	22.19	20.71	15.35	17.26	5.83
UT	2,102.97	2,157.78	1,838.57	24.14	24.77	24.47	35.19	36.11	24.85
VA	1,196.05	1,854.48	1,612.42	40.99	63.55	55.13	21.27	32.97	24.39
VT	4.65	62.89	173.96	88.61	1,197.84	1,016.50	11.83	159.89	136.04
WA	331.11	1,596.15	1,240.81	16.40	79.05	71.56	6.04	29.13	21.36
WI	1,720.13	2,122.22	1,789.46	25.52	31.48	36.34	28.28	34.89	25.23
WV	1,928.12	1,961.68	1,965.62	21.89	22.28	22.52	32.72	33.29	33.10
WY	2,251.46	2,329.45	2,141.24	25.68	26.57	25.98	37.24	38.53	33.46
	USCO2RTA	USCO2CRT	USNBCO2	USCH4RTA	USCH4CRT	USNBCH4	USN2ORTA	USN2OCRT	USNBN2O
US	1,329.35	1,810.88	1,583.28	27.27	37.14	35.77	20.60	28.07	19.97

Table 3. eGRID subregion and U.S. greenhouse gas annual output emission rates.

eGRID subregion acronym	eGRID subregion name	Carbon Dioxide (CO ₂) equivalent (lb/MWh)		
		total	combustion	non-baseload
AKGD	ASCC Alaska Grid	1,234.92	1,398.86	1,476.75
AKMS	ASCC Miscellaneous	500.56	1,471.94	1,462.06
ERCT	ERCOT All	1,329.43	1,536.16	1,121.04
FRCC	FRCC All	1,324.79	1,537.71	1,358.75
HIMS	HICC Miscellaneous	1,536.06	1,713.02	1,697.20
HIOA	HICC Oahu	1,821.60	1,821.60	1,864.07
MROE	MRO East	1,844.71	2,142.07	1,837.05
MROW	MRO West	1,831.95	2,314.25	2,170.67
NYLI	NPCC Long Island	1,544.83	1,544.83	1,514.46
NEWE	NPCC New England	934.77	1,367.73	1,321.12
NYCW	NPCC NYC/Westchester	817.90	1,456.32	1,529.06
NYUP	NPCC Upstate NY	724.79	1,561.44	1,520.77
RFCE	RFC East	1,145.51	1,887.36	1,798.93
RFCM	RFC Michigan	1,572.42	1,851.04	1,671.90
RFCW	RFC West	1,546.17	2,009.88	2,003.21
SRMW	SERC Midwest	1,840.41	2,113.95	2,111.90
SRMV	SERC Mississippi Valley	1,023.88	1,378.82	1,260.76
SRSO	SERC South	1,497.99	1,888.01	1,706.15
SRTV	SERC Tennessee Valley	1,518.81	2,085.62	2,009.14
SRVC	SERC Virginia/Carolina	1,141.51	1,923.88	1,790.63
SPNO	SPP North	1,971.39	2,295.62	2,180.31
SPSO	SPP South	1,665.67	1,746.24	1,383.29
CAMX	WECC California	727.26	1,230.96	1,085.56
NWPP	WECC Northwest	907.26	1,927.71	1,340.48
RMPA	WECC Rockies	1,892.47	2,074.12	1,624.42
AZNM	WECC Southwest	1,316.98	1,698.65	1,204.51
US		1,336.31	1,820.36	1,590.22

CONCLUSIONS

Because the authors have known of misuse of the eGRID emission factors in the past, we would like to provide some general guidelines in the form of recommendations as to when to use the two most important types of eGRID output emission rates and at what aggregation level to generally use these rates.

Recommendations for usage by emission rate type

The total output emission rate is the appropriate value to use for inventory development and carbon footprinting. The eGRID subregion total output emission rates are the default value proposed for use (along with electricity usage) for TCR and CCAR GHG indirect emission (scope 2) calculations, among other protocols.

eGRID non-baseload output emission rates can be useful when attempting to estimate the emissions benefits of reductions in electricity use, especially those that are somewhat coincident with peak demand. For example, if a user is interested in estimating the CO₂ emission reductions associated

with the installation of energy efficient equipment or products (e.g., an ENERGYSTAR heating, ventilating, and air conditioning (HVAC) system); or the installation of building envelop technologies (e.g. sealing air leaks and insulation improvements), then the user could use the eGRID subregion CO₂ non-baseload output emission rate and the expected or actual energy savings resulting from the installation to estimate the CO₂ emission reductions.

Non-baseload values may be less appropriate when attempting to determine the emissions benefits of some intermittent resources, such as wind power. Non-baseload values should not be used for assigning an emission value for electricity use in carbon footprinting or GHG emissions inventory efforts.

Recommendation for level of usage

Using eGRID subregion emission rates is highly recommended for most cases. An EGC may purchase power and/or export its power to other EGCs; state electricity generation may not serve all of the consumption within the state. eGRID subregion emissions and resource mix (based on generation, not consumption) uniformly attribute power in a specific region of the country and minimize this issue.

Recommendation for changes over time

If the task is to track emissions over the years, with one exception, the latest eGRID subregion output emission rates should be used when estimating scope 2 emissions from electricity use since these are the most recent and accurate data available. The one exception is for estimating GHG emissions for a historical year, in which case, the appropriate historical year's output emission rate should be used.

If the task is to determine whether a GHG emissions goal is being met, the latest eGRID subregion output emission rate should also be used in all cases, also with one exception. The one exception for this situation is for the case in which an eGRID subregion output emission rate increased from what was used in the baseline and would impede the entity from reaching its goal. In such a case, the output emission rates used for the baseline emissions should be used since the emission rate increase is a result of factors outside of the entity's control.

For example, if scope 2 emissions from electricity is the predominant source of an entity's emissions, and the entity reduced its electricity use by 25 percent, but the eGRID subregion output emission rate increased by 50 percent, the emissions from electricity use would be 12.5 percent higher than in the baseline. In such a case, for tracking purposes, the latest eGRID subregion output emission rate would be used, but for determining whether a goal had been met, the baseline's eGRID subregion output emission rate would be used if the latest eGRID subregion output emission rates are impeding the entity from meeting its goal.

For more details on any aspect of this paper, see the Technical Support Document¹, which can be downloaded from the eGRID website and/or email either of the authors at susy.rothschild@pechan.com or diem.art@epa.gov.

REFERENCES

1. E.H. Pechan & Associates, Inc., "The Emissions & Generation Resource Integrated Database for 2007 (eGRID2007) Technical Support Document," Prepared for the U.S. Environmental Protection Agency, Climate Protection Partnership Division, Washington, DC, September 2008.

KEY WORDS

eGRID
emissions
generation
resource mix
greenhouse gas
GHG emission factors
electric power
non-baseload
electricity
aggregation levels
combustion
carbon dioxide (CO₂)
carbon dioxide equivalent (CO₂e)
methane (CH₄)
nitrous oxide (N₂O)
eGRID subregion
NERC region
Environmental Protection Agency (EPA)
power control area (PCA)
Climate Leaders
The Climate Registry (TCR)
California Climate Action Registry (CCAR)
scope 2 emissions